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Motor control after anterior cruciate ligament reconstruction

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Document Version

Publisher's PDF, also known as Version of record

Publication date:

2015

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Gokeler, A. (2015). *Motor control after anterior cruciate ligament reconstruction*. [Thesis fully internal (DIV), University of Groningen]. [S.n.].

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INTRODUCTION

Of all athletic knee injuries, a rupture of the anterior cruciate ligament (ACL) is most common and most devastating, resulting in the greatest time lost from sport participation.¹ The ACL plays a vital role in the normal function and stability of the knee. Specifically, the native ACL consists of an anteromedial (AM) and posterolateral (PL) bundle, which together provide anterior and rotational stability of the knee.² Due to its inherent contributions to joint stability and function, when injured, it is widely accepted in the orthopedic community that treatment of choice for an active person should be surgical reconstruction.³

However, successful ACL-reconstruction (ACLR) in terms of restoring the mechanical stability of the knee joint does not ensure restoration of normal knee function. Moreover, despite the fact that surgical techniques and rehabilitation have evolved over the last decade, there is an ongoing debate related to the long term outcome of surgical versus a non-surgical approach.⁴ An ACL injury increases the risk of osteoarthritis (OA) and until now, ACLR has not been able to revert that course. Altered movement patterns after ACLR have been linked to early development of OA. It has been shown that for months and even years after ACLR, deficits in common daily activities as gait as well as athletic activities such as running and jumping and landing exist.

The aim of this dissertation is to contribute to the body of knowledge that may help us to understand the causes of altered movement patterns after ACLR.

OUTLINE OF THE DISSERTATION

Chapter 2

In chapter 2, the results of gait analysis conducted six months after ACLR are presented. In this study the relationships between frequent clinical outcome measurements such as strength and anterior laxity of the knee and gait parameters were determined. Previous studies reported on altered gait after ACLR but were more or less descriptive in nature. This study was undertaken to aid in our understanding as to why patients demonstrate altered gait patterns after ACLR. We chose the six months time frame to study these measures as it is common to release patients to sports after this period of rehabilitation.

Chapter 3

In one of our previous studies we determined that gait had returned to normal levels in only about a third of all patients at one year after ACLR.⁵ Gait can be considered an activity with relative low intensity and as most patients after ACLR desire to return to

high demanding activities, we were therefore interested in examining more demanding tasks in chapter 3. In the final stages of rehabilitation, hop test are commonly used to determine if patients after ACLR can return to sports. Thus, if hop tests are used as indicators of the functional performance after ACLR, it is imperative that a comprehensive assessment is carried out that includes a kinematic, kinetic and EMG-analysis. In this study, such a comprehensive examination was conducted in order to better understand the biomechanical and neuromuscular profiles at the time of release to sports.

Chapter 4

The first two experiments presented in this dissertation provided descriptive information related to altered function following ACLR. Additional proposed mechanisms are related to altered proprioception after ACL injury.⁶ The ACL contains mechanoreceptors which relay proprioceptive information to the central nervous system (CNS), which may activate the muscles around the knee for stabilization. However the precise mechanism is subject of controversy. In this chapter a literature review was conducted with the specific aim to find relationships between proprioception and often used clinical outcome measures as muscle strength, laxity, hop test, balance and patient-reported outcome.

Chapter 5

The two biomechanical studies that are presented in this dissertation, offer only descriptions of the changed movement patterns after ACLR. However they fail to provide an explanation of the phenomena encountered. In chapter 5, a new theoretical framework to fill this gap is presented. The contention is that patients after ACLR may utilize an increased attentional, cognitive focus on movements which inhibits the learning process to regain normal movements. We employed virtual reality as a tool to explore the effect of cognitive motor control during an easy and common daily task.

Chapters 6 and 7

In chapters 6 and 7, the findings of the research projects are summarized and placed in perspective with an outline for future research.

More specifically, thought-provoking issues are presented pertaining the potential causes of altered movements as well a paradigm change in terms of rehabilitation.



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